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MICHIGAN STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
EAST LANSING

THE QUARTERLY BULLETIN

The Quarterly Bulletin of the Michigan Agricultural Experiment Station is issued in February, May, August and November. It presents progress reports on long-term major research projects and final reports on short-term projects.

THE QUARTERLY BULLETIN

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MICHIGAN STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
EAST LANSING

C. M. HARDIN, DIRECTOR
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A GRAIN PLOT HARVESTER

By L. S. ROBERTSON and C. M. HANSEN

DEPARTMENTS OF SOIL SCIENCE AND AGRICULTURAL ENGINEERING

THE EXTENT of soil fertility investigations on field plots of small grains is frequently limited by the lack of a suitable harvesting machine.

Fig. 1. The "power-cradle" is a light-weight one-man machine for harvesting small grain plots. It is readily transportable.

ARTICLE 34-16

Standard harvesting machinery is not particularly adaptable because of its size or the damage which may be done to adjacent plots. For harvesting small plots, a mower is needed which will cut a swath directly ahead of the machine without damaging the uncut grain on either side of the swath. This machine needs to be of light weight in order that it can be readily transported and operated by one man.

A small harvesting machine has been developed to meet those needs. It is referred to as a "power-cradle". This machine uses a commercial, oscillating, sickle-type mower which cuts a 3-foot swath directly ahead of the power unit.

A grain reel to aid in cutting the grain and a sheet metal apron to catch the cut grain were added to this mower. The grain reel is ground-driven by two 10-inch-diameter wheels which were added to support the cutter bar. Adjustments can be readily made to vary the height and position of the reel with respect to the cutter bar. The speed of the reel and height of the cutter bar are also adjustable. During the 1951 harvest season extra handle bars were added to accommodate a tall operator. The machine is propelled by a 1½-horsepower gasoline engine which drives the two rear wheels by means of a hand clutch.

Plans for the construction of this machine may be obtained from the Agricultural Engineering Department, Michigan State College, East Lansing, Michigan.

MICHIGAN FARM BUSINESS REPORT FOR 1950

By J. M. NIELSON, E. M. ELWOOD and J. C. DONETH

AGRICULTURAL ECONOMICS EXTENSION

WHAT RETURNS can be expected from farming? What changes are taking place in farm organization? What are the characteristics of different type-of-farming areas of Michigan? Questions of this type are being answered by Michigan farmers through a continuous farm record-keeping project conducted in cooperation with the Department of Agricultural Economics and the farmers' own county agricultural agents.

Average results by years since 1929 are available for the state as well as for individual type-of-farming areas. This report summarizes some items over a 22-year period but presents in greater detail the results of the records from 826 Michigan farm account farms in 1950.

FARM EARNINGS

Net farm earnings on these account farms rose gradually over a 10-year period, reaching a peak in 1947 (Table 1). The post-war decline then set in, and net earnings declined in 1948 and 1949; they were expected to be even lower in 1950. However, Korea and our preparedness program changed this. The result was that net earnings (labor incomes) were boosted to $2,688 per farmer in 1950, as compared with $1,815 in 1949, $3,486 in the peak year 1947, and $1,346 for the last 22-year average.

Labor income represents what is left for the farmer's labor and management after all cash expenses, depreciation, family labor, and 5 percent interest on the investment have been taken out of gross income. In addition, the farm operator receives the value of farm products used in the home.

ARTICLE 34-17

TABLE 1—Farm earnings on farm accounting farms in Michigan by years, 1929-50

Year	Labor income	Year	Labor income
1929	$ 585	1940	$ 787
1930	−263	1941	1,675
1931	−676	1942	2,303
1932	−595	1943	1,990
1933	249	1944	2,406
1934	565	1945	2,483
1935	764	1946	3,374
1936	1,318	1947	3,486
1937	569	1948	2,735
1938	571	1949	1,815
1939	780	1950	2,688
22-year average (1929-50)			$1,346

Most of the increased earnings in 1950 were due to higher prices, although increases in cattle and hog numbers were also a contributing factor. Prices received by Michigan farmers rose from an index of 234 to 279 during the year. All income items showed increases (Table 2). Gross incomes increased $1,434, going from $8,369 in 1949 to $9,803 in 1950.

Expenses also increased but not so much as income. The index of prices paid by farmers rose from 249 to 272. All expense items, except crop expense and family labor, showed increases. Total expenses, including interest, rose from $6,554 in 1949 to $7,115 in 1950, an increase of $561.

The increases of $1,434 in gross incomes and only $561 in expenses resulted in labor incomes increasing $873, going from $1,815 in 1949 to $2,688 in 1950. This represented a 48-percent increase. Another evidence of the improved position of farmers in 1950 was that the purchasing power of Michigan farm products rose from 94 to 102 during the year.

The financial side of farming as shown in Table 2 has changed drastically over the last 10 years. The physical side of farming has also changed (Table 3). The size of farm has increased from 162 to 201 acres. The number of livestock units has increased from 20.8 to 31.7 per farm. On the other hand, there was the equivalent of 1.9 men per farm in pre-war years and only 1.6 men in 1950. The productive man work units per man (a measure of labor efficiency) have

TABLE 2—Comparison of gross income, expenses and labor incomes on farm accounting farms in Michigan, 1935-39 average, and by years 1946-50

Item	1935-39	1946	1947	1948	1949	1950
INCOME						
Crops	$ 881	$2,641	$2,663	$2,223	$2,085	$2,372
Dairy products	910	3,366	3,456	3,671	3,274	3,439
Cattle	338	894	1,082	1,209	1,094	1,719
Hogs	224	748	949	725	643	865
Poultry and eggs	256	711	805	827	782	810
Sheep	112	137	126	102	104	151
Other	161	221	351	415	387	447
	$2,882	$8,718	$9,432	$9,172	$8,369	$9,803
EXPENSES						
Feed bought	261	921	1,231	1,190	1,062	1,192
Machinery	291	922	1,162	1,365	1,497	1,658
Hired labor	231	767	634	665	628	684
Crop expense	193	741	770	863	877	774
Family labor	197	418	468	509	469	449
Improvements	138	317	349	373	422	454
Taxes	74	118	128	138	146	168
Other	56	209	216	215	285	482
	$1,441	$4,413	$4,958	$5,358	$5,386	$5,861
Net farm income	1,441	4,305	4,474	3,814	2,983	3,942
Interest on investment at 5%	641	931	988	1,079	1,168	1,254
LABOR INCOME	$ 800	$3,374	$3,486	$2,735	$1,815	$2,688

increased from 228 to 303. An important factor causing this increased labor efficiency has been an increase in machinery investment of about 3½ times per farm in the last 10 years.

TABLE 3—Comparison of size of farm, amount of livestock and amount of work, 1935-39 average and 1945-50 by years, Michigan

Item	1935-39	1946	1947	1948	1949	1950
Number of farms	1,150	838	830	846	912	826
Total acres	162	195	193	196	198	201
Tillable acres	107	133	134	136	136	138
Productive animal units	20.8	27.8	27.1	23.9	25.6	31.7
Productive man work units*	427	498	473	466	477	493
Number of men*	1.9	1.8	1.7	1.7	1.7	1.6
Work units per man*	228	284	286	281	292	303

*Fruit farms excluded.

TYPE-OF-FARMING AREA INFORMATION

The figures and information already presented pertain to an average of all farm account farms throughout the state. In addition to state average figures, the following tables (4, 5, 6 and 7) show information for all type-of-farming areas in the state (Fig. 1).

The net income increase already discussed was quite general throughout Michigan except in Area 7 where beans are an important cash crop and in Areas 12 and 16 where dairy, potatoes, and general crops are the major enterprises. Many beans were unmarketable because of the poor harvest season. Bean prices also continued unfavorable. Potato prices were the lowest for several years. In Area 16 crop yields were down and dairy product prices were not high enough to offset increasing farm costs.

Livestock continued to be the chief source of income on the farms in this project (Table 4). Livestock and livestock products contributed an income of $7,009 per farm in 1950 which amounted to 72 percent of the total. Crops contributed 24 percent and miscellaneous sources 4 percent.

It should be kept in mind that the farmers who kept the record books from which these tables were made were not necessarily typical of all farmers. Also, the farms in one area may be less representative than those in other areas. Figure 1 shows the counties included in each area.

Area Name

1. Corn and Livestock
2. Small Grains and Livestock
3. Southwestern Fruit and Truck Crops
4. Poultry, Dairy and Truck Crops
5. Dairy and General Farming
6. Dairy and Cash Crops
7. Dairy, Hay, and Special Crops
8. Beans, Sugar Beets, and Dairy
9. Cattle, Sheep, and Forage
10. Central Potato and Dairy
11. Northern Fruit and Dairy
12. Northern Potato and Dairy
13. General, Self-Sufficing, and Part-Time
14. Cattle, Potatoes, and Self-Sufficing
15. Cattle, Hay, and Spring Grains
16. Dairy and Potatoes
17. Potatoes, Dairy, and Part-Time

Fig. 1. Type-of-farming areas in Michigan

TABLE 4—Financial summary of 826 Michigan farms by type-of-farming areas, 1950

Number of farms	All farms	Type-of-farming areas														
		1	2	3&11	4	5	6	7	8	9	10	12	14	15	16	17
	826	101	70	40	46	163	35	36	63	33	43	50	52	19	26	49
Total acres	201	186	218	153	161	229	224	218	162	234	215	206	211	217	168	165
Percent of farm acres tillable	69	77	79	73	76	75	79	82	76	50	61	57	48	68	48	44
Tillable acres	138	144	172	112	122	171	176	179	123	118	131	118	102	148	80	73
Real estate (less house)	$13,369	$14,741	$14,802	$21,256	$11,089	$17,353	$18,344	$16,106	$15,283	$ 9,710	$10,168	$ 7,374	$ 7,765	$ 4,478	$ 7,620	$ 5,782
Machinery and equipment	5,264	5,512	5,274	6,314	5,294	6,266	6,570	6,700	5,892	4,384	4,692	3,736	3,385	3,561	4,078	3,656
Livestock	3,859	4,866	4,430	2,052	3,616	5,243	4,998	4,938	3,653	4,146	3,322	2,017	2,200	4,499	2,897	1,770
Feed and crops	2,649	3,663	3,348	1,795	2,682	3,800	3,482	3,059	3,062	1,273	1,926	1,629	1,097	962	1,104	685
Capital investment	$25,141	$28,782	$27,854	$31,417	$22,681	$32,662	$33,394	$30,803	$27,890	$19,513	$20,108	$14,756	$14,447	$13,800	$15,699	$11,893
Livestock income	$ 7,009	$ 8,429	$ 8,961	$ 3,433	$ 8,704	$ 9,233	$ 8,935	$ 7,452	$ 7,265	$ 5,705	$ 6,045	$ 3,584	$ 3,702	$ 4,404	$ 5,889	$ 3,495
Crop income	2,372	2,241	2,356	11,779	1,763	2,431	2,460	1,632	3,715	496	1,775	1,133	675	1,044	169	710
Other income	422	393	659	490	291	467	260	445	486	434	458	274	152	240	323	580
Gross income	$ 9,803	$11,063	$11,976	$15,702	$10,758	$12,131	$11,655	$ 9,529	$11,466	$ 6,635	$ 8,278	$ 4,991	$ 4,529	$ 5,688	$ 6,381	$ 4,785
Total expense	5,861	6,228	7,244	10,892	6,778	6,804	7,301	6,694	5,998	3,689	4,972	3,398	2,886	3,195	4,200	3,044
Net farm income	$ 3,942	$ 4,835	$ 4,732	$ 4,810	$ 3,980	$ 5,327	$ 4,354	$ 2,835	$ 5,468	$ 2,946	$ 3,306	$ 1,593	$ 1,643	$ 2,493	$ 2,181	$ 1,741
Less interest @ 5%	1,254	1,446	1,423	1,571	1,095	1,640	1,498	1,586	1,411	960	1,006	763	720	637	765	595
Labor income 1950	$ 2,688	$ 3,389	$ 3,309	$ 3,239	$ 2,885	$ 3,687	$ 2,856	$ 1,249	$ 4,057	$ 1,986	$ 2,300	$ 830	$ 923	$ 1,856	$ 1,416	$ 1,146
Labor income 1949	1,815	2,079	2,160	2,130	1,927	2,647	2,534	2,543	2,955	930	1,564	873	917	576	1,625	309
Labor income 1948	2,735	3,954	2,903	3,923	2,930	3,014	3,042	3,267	3,777	2,482	2,517	2,000	1,233	1,491	2,960	1,657
Labor income 1947	3,486	4,596	4,300	3,859	3,753	4,710	3,793	2,720	4,501	2,310	2,391	1,617	2,094	2,355	3,050	1,668
Labor income 1946	3,374	4,337	3,169	12,013	3,011	3,312	2,988	3,585	4,413	2,489	2,485	2,221	2,066	2,267	2,954	2,357
Labor income 1945	2,483	3,432	2,464	4,101	2,710	3,228	2,807	2,181	2,978	1,514	2,226	1,554	1,613	1,345	1,766	1,653
Labor income 1944	2,406	2,719	1,452	9,367	2,409	2,496	2,712	2,753	2,940	1,815	2,393	1,819	1,613	1,661	1,850	1,551
Labor income 1943	1,990	2,235	2,473	8,065	2,101	2,222	2,378	1,502	2,272	929	1,704	1,380	1,098	670	1,683	1,080
Labor income 1942	2,303	3,056	2,389	5,443	2,142	2,763	2,856	2,673	2,543	1,636	2,330	1,489	1,253	1,346	1,601	1,193

*Includes family labor, but not operator's labor or interest on investment.

TABLE 5—Kinds of crops and percentage of tillable land in different crops and also yields by type-of-farming areas in Michigan, 1950

Number of farms	All farms	Type-of-farming areas														
		1	2	3&11	4	5	6	7	8	9	10	12	14	15	16	17
	826	101	70	40	46	163	35	36	63	33	43	50	52	19	26	49
Number of tillable acres	138	144	172	112	122	171	176	179	123	118	131	118	102	148	80	73
Percent in sod crops	44	34	44	31	39	40	45	46	32	57	48	56	60	63	62	71
Percent in legumes	32	29	37	20	32	34	34	34	28	37	36	30	42	35	48	31
Percent tillable acres in:																
Tillable pasture	17	12	20	14	15	17	21	21	12	25	19	21	20	21	16	14
Alfalfa hay	13	13	12	7	12	13	13	13	15	19	13	8	20	4	23	6
Other hay	14	9	12	10	12	10	11	12	5	13	16	27	20	38	23	51
Corn (includes silage)	16	29	18	7	19	19	14	9	18	14	13	9	5	.....	11	.....
Wheat	10	14	15	4	14	14	10	9	10	5	7	3	6	2	.....	1
Oats (oat mixtures)	14	15	13	5	19	14	14	16	12	16	14	15	12	16	20	16
Barley	1	.....	1	.....	1	1	.....	.....	4	2	.....	.....	3	.....	2	1
Beans	2	.....	.....	.....	.....	1	5	10	12	1	1	.....	.....	.....	.....	.....
Sugar beets	1	.....	.....	.....	.....	1	1	5	7	.....	.....	.....	.....	.....	.....	.....
Potatoes	1	.....	.....	.....	.....	.....	1	.....	.....	.....	2	5	1	.....	.....	2
Fruit and truck	2	.....	.....	42	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Other	6	5	4	7	7	6	7	4	4	4	12	10	10	18	5	7
Idle	2	2	3	4	1	2	3	1	1	1	3	2	1	1	.....	2
Seeds	1	1	2	.....	.....	2	.....	.....	.....	.....	.....	.....	2	.....	.....	.....
Crop yield per acre:																
Alfalfa hay	2.1	2.1	2.0	1.9	2.4	2.3	1.9	2.1	2.5	1.5	2.2	1.4	1.4	1.4	1.6	1.9
Other hay	1.4	1.6	1.4	1.6	1.4	1.5	1.6	1.6	1.8	1.4	1.4	1.1	1.1	1.2	1.4	1.6
Corn, silage	8.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	8.0	.....
Corn, shelled	46	48	41	43	49	47	48	38	57	36	38	32	13	.....	.....	.....
Wheat	27	29	21	21	28	28	37	21	31	21	34	15	17	9	.....	37
Oats	42	39	37	43	47	43	50	48	52	38	37	34	34	40	47	44
Barley	32	.....	35	.....	39	29	.....	.....	.....	29	.....	.....	31	.....	35	29
Beans	14	.....	.....	.....	.....	.....	.....	10	19	.....	14	.....	.....	.....	.....	.....
Sugar beets	9	.....	.....	.....	.....	8.2	6.0	5.8	12.3	.....	.....	.....	.....	.....	.....	.....
Potatoes	238	.....	.....	.....	.....	.....	.....	.....	.....	.....	292	237	290	.....	.....	255
Crop yield index	100	102	88	97	107	89	108	95	124	82	92	117	71	86	96	106
Crop sales & PMA payments	$2,134	$1,904	$2,258	$11,136	$1,326	$2,274	$2,114	$1,737	$3,227	$ 284	$1,667	$1,076	$ 511	$ 744	$ 165	$ 313
Crop income, total	2,372	2,241	2,356	11,779	1,763	2,431	2,460	1,632	3,715	496	1,775	1,133	675	1,044	169	710
Feed bought	1,192	1,502	1,868	987	2,269	1,335	1,049	1,133	1,165	691	1,015	452	478	638	1,194	671

TABLE 6—Livestock: Kinds, amounts and returns from livestock by type-of-farming areas in Michigan, 1950

Number of farms	All farms	Type-of-farming areas														
		1	2	3&11	4	5	6	7	8	9	10	12	14	15	16	17
	826	101	70	40	46	163	35	36	63	33	43	59	52	19	26	49
Livestock income, total	$7,009	$8,308	$8,961	$3,433	$8,714	$9,233	$8,935	$7,452	$7,266	$5,705	$6,046	$3,533	$3,704	$4,499	$5,889	$3,494
Livestock income per T.A.*	$ 52	$ 58	$ 52	$ 53	$ 71	$ 54	$ 51	$ 42	$ 59	$ 48	$ 46	$ 30	$ 36	$ 30	$ 74	$ 48
Productive animal units	31.7	38.0	38.3	14.1	30.2	39.1	32.2	32.3	28.7	28.3	26.0	19.2	21.2	21.0	24.2	17.8
Tillable acres per P.A.U.**	4.5	3.8	4.5	4.6	4.0	4.4	5.5	5.5	4.3	4.2	5.1	6.1	5.0	7.0	3.3	4.1
CATTLE:																
Percent farms reporting	95	97	96	70	98	96	97	92	97	94	98	98	98	100	96	98
Cows per farm reporting	13.6	12.4	14.7	9.4	13.4	16.0	18.1	18.8	12.4	14.3	12.4	9.9	9.6	10.3	16.4	12.0
Dairy sales per cow	$ 265	$ 271	$ 264	$ 248	$ 281	$ 294	$ 317	$ 278	$ 290	$ 219	$ 249	$ 193	$ 176	$ 209	$ 268	$ 217
Dairy sales per farm reporting	$3,604	$3,346	$4,060	$2,321	$3,760	$4,690	$1,889	$5,219	$3,607	$3,121	$3,082	$1,900	$1,686	$2,141	$4,398	$2,590
Income per farm reporting	$1,466	$1,967	$2,007	$1,350	$1,775	$2,229	$8,361	$1,865	$1,907	$2,054	$1,911	$1,070	$1,480	$1,083	$1,304	$ 762
HOGS:																
Percent farms reporting	59	85	73	.....	57	53	29	25	70	67	60	90	79	53	46	14
Sows per farm reporting	3.2	4.8	5.9	.....	1.7	5.1	1.6	1.7	2.7	2.3	1.4	1.2	1.2	***	1.2	***
Litters farrowed per farm	5.2	9.1	10.2	.....	2.7	9.1	2.9	2.4	4.8	2.8	2.3	2.0	1.6	***	1.8	***
Pigs weaned per litter	6.6	6.5	6.5	.....	7.3	6.3	7.3	7.9	6.5	7.3	7.0	6.5	8.1	***	7.4	***
Hog income per litter	260	266	259	.....	308	258	257	159	318	275	220	175	195	***	254	***
Income per farm reporting	$1,476	$2,419	$2,657	.....	$ 830	$2,337	$ 747	$ 387	$1,532	$ 763	$ 508	$ 354	$ 309	$ 145	$ 445	$ —9
SHEEP:																
Percent farms reporting	11	11	21	.....	.....	20	9	5	11	18	.....	6	8	16	4	6
Ewes per farm reporting	42	56	44	.....	.....	50	60	19	28	27	.....	37	37	23	8	***
Lambs raised per 100 ewes	97	83	89	.....	.....	97	94	100	114	100	.....	131	109	134	100	***
Sheep income per ewe	32	24	30	.....	.....	33	35	20	33	34	.....	37	27	28	21	***
Income per farm reporting	$1,371	$1,331	$ 452	.....	.....	$1,251	$2,084	$ 378	$ 939	$ 919	.....	$1,361	$ 991	$ 661	$ 169	$ 50
POULTRY:																
Percent of farms reporting	69	81	44	63	89	75	74	61	75	52	63	72	77	84	62	41
Hens per farm reporting	155	191	273	125	374	135	181	128	120	43	178	78	62	130	74	70
Egg sales per hen	$ 5.40	$ 5.18	$ 5.67	$ 6.87	$ 6.25	$ 5.26	$ 5.51	$ 4.54	$ 4.98	$ 4.31	$ 5.23	$ 4.28	$ 3.98	$ 5.81	$ 3.83	$ 4.66
Egg sales per farm reporting	834	990	1,551	863	2,339	712	996	582	599	187	929	335	245	783	283	326
Income per farm reporting	343	322	712	335	804	429	289	108	407	147	401	45	107	184	30	65

*T.A.—Tillable Acres **P.A.U.—Productive Animal Units ***Data not comparable

TABLE 7—Expenses and efficiency factors, labor, machinery, improvements and other costs by type-of-farming areas in Michigan, 1950

Number of farms	All farms	Type-of-farming areas														
		1	2	3&11	4	5	6	7	8	9	10	12	14	15	16	17
	826	101	70	40	46	163	35	36	63	33	43	50	52	19	26	49
Gross income per T.A.	$70.91	$76.87	$69.49	$139.71	$87.96	$70.93	$66.35	$53.09	$92.84	$56.30	$63.07	$42.43	$44.28	$38.78	$79.72	$65.47
Total expense per T.A.*	53.16	53.69	51.12	109.79	67.30	48.94	49.10	45.44	60.66	42.49	48.46	39.84	40.95	30.15	67.85	59.18
Total expenses*	7,348	7,715	8,809	12,339	8,231	8,371	8,625	8,157	7,491	5,008	6,357	4,687	4,188	4,463	5,430	4,325
Man labor:																
Number of men†	1.6	1.6	1.7	2.9	1.6	1.7	1.9	1.9	1.7	1.5	1.7	1.5	1.4	1.4	1.5	1.5
Income per man	$5,810	$7,079	$7,056	$5,447	$6,741	$7,042	$6,107	$5,090	$6,814	$4,388	$4,971	$3,349	$3,192	$4,055	$4,343	$3,256
Days of work per man†	303	346	333	.....	352	341	315	318	295	279	273	237	214	263	269	216
Hired	$ 684	$ 442	$ 717	$3,697	$ 922	$ 632	$ 983	$ 732	$ 461	$ 162	$ 513	$ 303	$ 244	$ 339	$ 420	$ 297
Family	449	471	496	494	297	486	572	648	548	478	467	326	317	253	279	360
Operator	1,431	1,487	1,510	1,447	1,453	1,523	1,508	1,416	1,493	1,320	1,385	1,295	1,303	1,267	1,252	1,281
Expense per T.A.	18.55	16.70	15.80	50.16	21.84	15.45	17.44	15.58	20.26	16.63	18.02	16.36	18.22	12.56	24.38	26.51
Power and machinery:																
Investments	$5,264	$5,512	$5,274	$6,314	$5,294	$6,266	$6,570	$6,700	$5,892	$4,384	$4,692	$3,736	$3,385	$3,561	$4,078	$3,656
Income per $1000 investment	2,063	2,004	2,270	2,486	2,032	1,936	1,774	1,422	1,946	1,513	1,764	1,335	1,338	1,612	1,565	1,309
Annual expense	1,658	1,831	1,845	2,043	1,593	2,017	2,023	2,147	1,883	1,238	1,454	1,173	949	1,038	1,218	859
Expense per T.A.	11.99	12.75	10.70	18.17	13.02	11.79	11.51	11.96	15.25	10.51	11.08	9.97	9.28	7.01	15.22	11.76
Improvements:																
Investment (less house)	$6,282	$7,503	$6,803	$7,602	$5,674	$8,578	$8,604	$7,101	$7,125	$4,517	$4,771	$3,042	$3,272	$2,998	$3,944	$3,062
Investment per A.U.	208	198	178	.....	187	220	267	219	248	160	184	159	160	143	163	172
Income per $1000 investment	1,560	1,472	1,760	2,065	1,896	1,414	1,354	1,341	1,609	1,469	1,735	1,640	1,385	1,915	1,618	1,563
Annual expense	454	519	548	561	391	637	605	512	475	334	332	221	231	218	279	213
Expense per T.A.	3.28	3.61	3.18	4.99	3.19	3.72	3.44	2.85	3.84	2.83	2.53	1.88	2.26	1.47	3.49	2.92
Feed bought	$1,192	$1,502	$1,868	$ 987	$2,269	$1,335	$1,049	$1,133	$1,165	$ 691	$1,015	$ 452	$ 478	$ 638	$1,194	$671
Crop expense	774	767	977	2,312	591	890	990	802	750	333	676	554	345	355	422	305
Custom work	144	198	227	90	138	179	216	169	164	116	115	74	88	99	45	106
Taxes	168	170	205	187	185	244	157	194	188	103	115	86	64	73	75	56
Other expense	394	328	416	521	392	428	522	404	364	233	285	203	169	183	246	177
Feed bought per T.A.	$ 8.63	$10.45	$10.84	$ 8.78	$18.55	$ 7.81	$ 5.97	$ 6.31	$ 9.43	$ 5.86	$ 7.74	$ 3.84	$ 4.68	$ 4.31	$14.92	$ 9.17
Crop (less custom) Exp. @ T.A.	5.60	5.34	5.67	20.57	4.84	5.20	5.64	4.47	6.07	2.82	5.15	4.71	3.38	2.40	5.27	4.18
Custom work per T.A.	1.05	1.37	1.32	.80	1.13	1.04	.90	.94	1.33	.98	.88	.63	.86	.67	.57	1.46
Taxes per T.A.	1.21	1.18	1.19	1.66	1.52	1.43	1.23	1.08	1.52	.87	.88	.73	.62	.49	.94	.78
Other expenses per T.A.	2.85	2.29	2.42	4.66	3.21	2.50	2.97	2.25	2.96	1.99	2.18	1.72	1.65	1.24	3.06	2.40

*Includes operator's and family labor but not interest on investment. †Fruit farms excluded.

THE USE OF CHLORDANE FOR THE CONTROL OF CRABGRASS (A Preliminary Report)

By B. H. GRIGSBY

DEPARTMENT OF BOTANY AND PLANT PATHOLOGY[1]

AN EXAMINATION of certain publications dealing with insecticides revealed that some of the more recently developed organic insecticides seem to have some herbicidal effects on various species of crop plants and weeds. One of the insecticides, chlordane, when placed in the soil, was reported to have residual effects which affected the germination of seeds. Because of this fact, greenhouse experiments were made to determine whether crabgrass seed germination could be inhibited.[2]

In early January 1951, wood flats were filled with sandy loam soil, and approximately 1 tablespoonful of crabgrass seeds was sown on the surface of the soil. The flats were then watered by flooding; as a result, the grass seeds were drawn into close contact with the soil but not covered by a thick layer. The following day the flats were sprayed with enough of an emulsifiable concentrate of chlordane to be equivalent to rates of 5 to 10 pounds of actual chlordane per acre.

Within 10 days the flats which had not received any chemical treatment had produced an abundant stand of crabgrass as well as some broad-leaved weeds. No crabgrass or broad-leaved weeds were present in the chlordane-treated flats.

All flats were kept for 6 weeks, and at the end of that time it was found that some crabgrass was present in all flats, but the amounts in the chlordane-treated ones were much less than in the untreated flats.

Another group of flats, prepared in the same way, were seeded on March 9 with a mixture of lawn grass seeds to which a small amount of crabgrass seed had been added. The chief species of lawn grasses in the mixture were Kentucky blue grass, Chewings fescue and perennial ryegrass. Chemical treatments were applied within 24 hours after

[1]In cooperation with the Division of Weed Investigations, Bureau of Plant Industry, Soils and Agricultural Engineering.

[2]These experiments were supported, in part, by a grant from the Standard Oil Company (Indiana). Contribution No. 51-9, Department of Botany and Plant Pathology.

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seeding. The chemicals used and results obtained are shown in Table 1. These observations were made 28 days after seeding.

TABLE I—Effects of chemicals on the emergence of crabgrass and lawn grass seedlings

Chemical used	Rate in pounds per acre	Percent emergence	
		Crabgrass	Lawn grasses
None	—	100	100
Chlordane (in L-2687)	15	0	50
Chlordane (in L-2687)	20	0	30
Chlordane (in L-2687)	25	0	30
TCA	5	0	5 (ryegrass)
Dichlorol urea	5	0	25
IPC	5	100	50

A highly refined oil has been found to be an effective selective herbicide for crabgrass in lawns.[3] However, this oil does not produce a rapid kill of crabgrass and repeated applications are required. An effort was made to extend the effectiveness of the method by the inclusion of chlordane. For this purpose, enough technical chlordane resin to be equivalent to 10 pounds per acre was dissolved in the crabgrass spray oil and the mixture applied to flats for crabgrass. The grass was in a two- to four-leaf stage of growth at the time of treatment. Four days after spraying, all the crabgrass was dead and dry. Similar plants sprayed with the oil alone were red, stunted, but still living, and a second spraying was required to kill them.

During the summer of 1951, June through August, an extensive series of lawn plots were treated with chlordane in various oil carriers and it was found in these trials that the addition of chlordane markedly increased the effectiveness of the oils and reduced the time required for killing crabgrass. Chickweed plants present in these plots were killed as readily as was crabgrass.

The trials were made on various lawn grass mixtures and on three types of bent grass. Kentucky blue grass, Astoria bent and annual blue grass showed no ill effects from the treatments. Seaside and Washing-

[3]Grigsby, B. H., Selective Control of Crabgrass. Mich. Agr. Expt. Sta. Quart. Bul. 30:369-373. 1948.

ton bent developed a slight yellow color, which lasted for about two weeks. Chewings fescue was occasionally discolored by the treatments, but no permanent damage was observed.

DISCUSSION

The results obtained in greenhouse trials indicate that chlordane has the property of delaying emergence and preventing germination of crabgrass seeds. It also has some effect upon the germination of other grass seeds. This fact is important because all crabgrass control methods now in use are unsatisfactory inasmuch as they do not affect seed germination, and repeated applications are required after the original treatment.

Our observations indicate that bests results may be expected when the technical resin form of chlordane is used in an oil carrier. Emulsifiable concentrates have some effect, but seem less active than the technical product.

The dosage rates used in these trials, 5 to 25 pounds, were within the range used for the control of grubs and other soil-inhabiting insects. Thus, it is apparent that applications of chlordane may have both insecticidal value and herbicidal value. While no data were secured in regard to residual effects of chlordane on crabgrass emergence, visual observations during the season indicated that there were fewer new crabgrass seedlings in the chlordane plots than in the other plots.

Further trials over a longer period of time are needed to determine whether chlordane will inhibit crabgrass germination in treated sod.

Results from applications of chlordane in crabgrass spray oil, or in kerosene, showed clearly that the insecticide would increase the crabgrass-killing properties of these oils without causing undesirable effects on turf grasses. Refined oils alone are slow in action and repeated treatments are required during the growing season. The method described enables one to secure a quick kill of crabgrass with a single application of spray mixture and also leaves a residue in the soil which may prevent reinfestation later in the season. Best results were obtained when kerosene was used as the carrier.

The very mild effect of chlordane on bent grass offers the possibility of the use of cholrdane for crabgrass control on golf greens. In such locations the treatment may be made on small patches of crabgrass or to an entire green if the weed grass is abundant. Some retarding effect may occur, but the bent grass will not be killed and soil

fertilization prior to the herbicidal application should make a rapid recovery possible.

Application of chlordane in oil may produce a quick defoliation of perennial broad-leaved weeds and clover, but these plants soon recover. Annual weeds may be destroyed by a single treatment.

These preliminary tests represent a new approach in that an insecticide was combined with a herbicide in order to secure greater herbicidal properties. Only chlordane was used in the experiments reported here but work is under way in which other insecticides are combined with herbicidal oils. Results are not yet available but there are indications that such combinations may extend the usefulness of certain compounds and that synergistic effects may be obtained by such combinations.

SUMMARY

1. Applications of 5 to 25 pounds chlordane per acre to soil in which crabgrass seeds were germinating reduced the emergence of crabgrass seedlings.

2. Foliage applications of 5 to 10 pounds chlordane per acre, in a refined oil carrier gave a rapid kill of crabgrass without injury to lawn grass.

3. Crabgrass plants can be killed at any stage of growth by the mixture.

4. Bent grasses appear to be tolerant of the oil-chlordane mixture.

5. Chickweed can be killed about as readily as crabgrass with chlordane in oil.

DRY TREATMENT OF WHEAT FOR LOOSE SMUT[1]
(A Preliminary Report)

By R. W. KLEIS, E. H. LUCAS, H. M. BROWN, and D. J. de ZEEUW
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Loose smut of wheat is one of the diseases of this highly important cereal grain which can be controlled by using disease-resistant strains or by using what is known as the hot water treatment.

The hot water method requires soaking the grain for 4 hours in cool water, heating for 10 minutes in a hot water bath precisely controlled between 128 and 130 degrees F., cooling and drying. The use of this treatment has been limited, not by its lack of effectiveness nor by the reductions in germination, but to a great extent by the necessity of re-drying the grain before planting.

Experiments conducted by E. H. Lucas in 1949 indicated that dry heat from a 250-watt infra-red lamp might be effective in the control of loose smut and would eliminate the necessity of soaking and then drying the grain. In this test the height of lamp above the grain was 12 inches, the temperature of heating, as read from a thermometer in same plane as the wheat but not touching the wheat, was 53.8 degrees C. and the length of exposure to reach this temperature from room temperature was 170 seconds.

As a result of these earlier experiments, it was decided in the late summer of 1950 to conduct tests with two methods of dry heating, radiant and dielectric, to determine their effectiveness and practicability.

Laboratory equipment was designed for radiant heating, using a 250-watt heat lamp as a generator. The lamp was mounted directly above and directed down toward the wheat sample which was arranged in a layer, one kernel thick on a heavy canvas, such as would be used for continuous operation equipment. Wheat temperature, in degrees centigrade was measured by means of a copper-constantan thermo-

[1]The subject of this paper is treated in more detail in the thesis of the senior author, submitted to the School of Graduate Studies, Michigan State College, in 1951.

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couple placed inside a kernel of wheat. The lead wires were covered with other kernels of wheat to shield them from direct radiation. Yorkwin (white) and Fairfield (red) winter wheats with 8-percent moisture were heated with the lamp set at a height of 12, 15, and 18 inches from grain to closest part of lamp bulb. Fairfield heated faster than Yorkwin, with the difference in time of heating varying from 10 to 100 seconds depending upon lamp height and the temperature to which the grain was raised as indicated by the thermocouple reading. The smaller differences in time tended to be associated with the smaller distance between grain and lamp. To heat to 55 degrees C. with the 12-inch height required 185 seconds for Fairfield and 195 seconds for Yorkwin, while with the 15-inch height it took 405 seconds for Fairfield and 495 for Yorkwin. With the 18-inch setting the samples of neither variety were raised above 53 degrees C.

To determine the approximate temperature at which injury occurred and germination showed a sharp drop, samples of Fairfield and Yorkwin, both with 8-percent moisture, were subjected to temperatures from 50 to 120 degrees C. with a lamp height of 8 inches. The treated samples were then germinated in petri dishes. The temperature at and above which germination of the wheat was injured was found to be between 80 and 90 degrees C.

Samples of Yorkwin were brought from 8-percent moisture up to 10, 13, 18 and 23 percent by the addition of water and allowing 24 hours for samples to come to equilibrium. Subsamples from each moisture content were then subjected to temperatures of 75 to 95 degrees C. at 5 degree intervals with lamp height at 8 inches and germination tests run. The germination percentages for the 75-, 80-, and 85-degree points of the four moisture contents were not consistently above or below one another and not very different from the control. At the 90- and 95-degree points distinct trends became noticeable. The germination percentages for seed heated to 95 degrees C. were 80 percent for 10-percent moisture, 70 for 13-percent moisture, 58 for 18-percent moisture and 56 for 23-percent moisture.

Another test using loose-smut-infected American Banner (white) and Goens (red), both with 12-percent moisture showed germination injury at a temperature of 86 degrees C. for American Banner and at 82 degrees C. for Goens. Lamp height was 8 inches.

To determine the effect of radiant heating on loose smut incidence, samples of American Banner and Goens at 12-percent moisture were

placed under the heat lamp set at a 10-inch height. The American Banner samples were subjected to temperatures of 78, 80, 82, 84, 86, 88, and 90 degrees C., while the Goens samples were subjected to temperatures of 75, 77, 79, 81, 83, 85 and 87 degrees C. Four 100 kernel subsamples were taken from each treatment and planted 100 kernels to a row in a randomized split-plot arrangement in the field, Sept. 27, 1950. Emergence counts were made 3 weeks after planting. Survival counts were made in the Spring, 1951, and smut incidence counts made at full heading time. The length of treatment of American Banner varied from 270 seconds at 78 degrees C. to 481 seconds for 90 degrees C., and of the Goens samples from 315 seconds at 75 degrees C. to 475 seconds at 87 degrees C. Only at the highest temperature was smut incidence reduced to zero. A comparison of the control data with the highest temperature data shows that in American Banner emergence was lowered from 83 to 63 percent, spring survival from 62 to 46 percent and total number of heads from 353 to 181. In Goens, emergence was lowered from 81 to 76 percent, spring survival from 65 to 62 percent and total number of heads from 361 to 359.

During the winter and spring terms of 1951, tests were run, using dielectric heating. The preliminary tests involved the determination of what effect the moisture content of the wheat grains would have on the dielectric constant and power factors of that grain. A test capacitor was built for this purpose. It was found that as the moisture content of the grain (Vigo) rose from 9.81 to 21.40 percent, the dielectric constant increased from 4.74 to 6.97 in almost a direct relationship. The power factor increased from 8 to 40 in an exponential relationship.

With this preliminary work as a basis, the heating unit for the remaining tests was constructed. Two circular galvanized iron plates 9 inches in diameter were mounted on a half-inch thermal insulation board backed by half-inch plywood. The bottom plate was stationary while the upper plate was hinged. A light cardboard ring one-inch wide of low heat capacity, rigid enough to hold up, with a dielectric constant of 3.5, and with a diameter of 4.78 inches, giving a volume of 18 cubic inches, was used to contain the 227 gram samples of wheat. This quantity of wheat filled the ring, allowing the plates, top and bottom, to be in contact with the grain.

The source of power was a one-kilowatt Westinghouse industrial radio-frequency generator. A thermocouple was introduced into the center of the sample of wheat through a small hole in the ring. Read-

ings were made on cut-off temperature, time of heating and "60-second" temperature—that is, the temperature 60 seconds after the power was shut off. The temperature readings 60 seconds after power shut-off were taken to eliminate the effect of the high frequency electrostatic field on the thermocouple reading.

Yorkwin with a moisture content of 9.8 per cent was used to determine the temperature at which germination of the wheat was adversely affected. The "60-second" temperatures of this test ranged from 56 to 100 degrees C. A "60-second" temperature close to 90 degrees C. was found to be injurious to germination. There was a fair relationship between length of time of heating and "60-second" temperature but not between time and cut-off temperature. This condition prevented exact repetition of temperature with this particular arrangement of equipment.

Thirty-two samples of loose-smut-infected Illinois No. 1-128 spring wheat were subjected to various temperatures for field tests on the resulting incidence of loose smut. In each case, a 100-kernel sample for space planting was taken from the central portion of the sample while still in the retainer ring. The remainder of each half pound (227 grams) lot was put in a bag and used to plant a 4-row plot 16 feet long. Heating times varied from 277 seconds for a "60-second" temperature of 78.8 degrees C. to 618 seconds for a "60-second" temperature of 99.0 degrees C.

There were no consistent results from the space planted plots as to temperature and smut incidence nor as to length of time of treatment and smut incidence. In none of the 4-row plots was the loose smut incidence down to zero.

The general conclusions from this preliminary work are that loose smut may be controlled by radiant heating but that color and moisture content of grain are factors which must be considered. The methods used with dielectric heating were not satisfactory. Both radiant and dielectric heating methods need further investigation before adequate methods are evolved.

INHERITANCE OF HATCHING POWER IN NINE GENERATIONS OF DARK CORNISH,[1]

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CONSIDERABLE evidence in the literature is that hatching power is inherited, but a goodly portion of it is of a negative nature. Some 16 "embryonic lethals" were postulated by Landauer (1948) as reasons for hatching failures. Few data demonstrate a positive hereditary influence on hatching power. Hays and Klein (1924) reported positive results in improving hatchability in 10 generations of Rhode Islands Reds, and Jeffrey (1944) reported similar results in White Leghorns over a 5-year period. Published records of as many as nine generations of Dark Cornish, such as have been compiled at the Michigan Station, have not come to the writer's attention.

HOW DATA WERE OBTAINED

The hatching data presented in Table 1 and Fig. I were accumulated at the Michigan Station during an investigation of the inheritance of meat type and egg production. Egg production was the principal objective in the Cornish lines, with selection for better hatching power being subordinate. The hatching data were recorded for the majority of the population of Dark Cornish pullets and consist of the performance of pullets mated during their first hatching season. Hatchery records were not obtained for all individuals of each line since selection for mating of pullets was based primarily on egg production promise. The hatching performance population was sampled, therefore, entirely at random.

METHOD OF AVERAGING

The averages in Table 1 are the average of the individual averages of each pullet. The variation, therefore, is not biased by difference in numbers of eggs set. The percentage hatch consists of the percentage

[1]Presented at the annual meeting of Poultry Science Association, Knoxville, Tennessee, August 1951.

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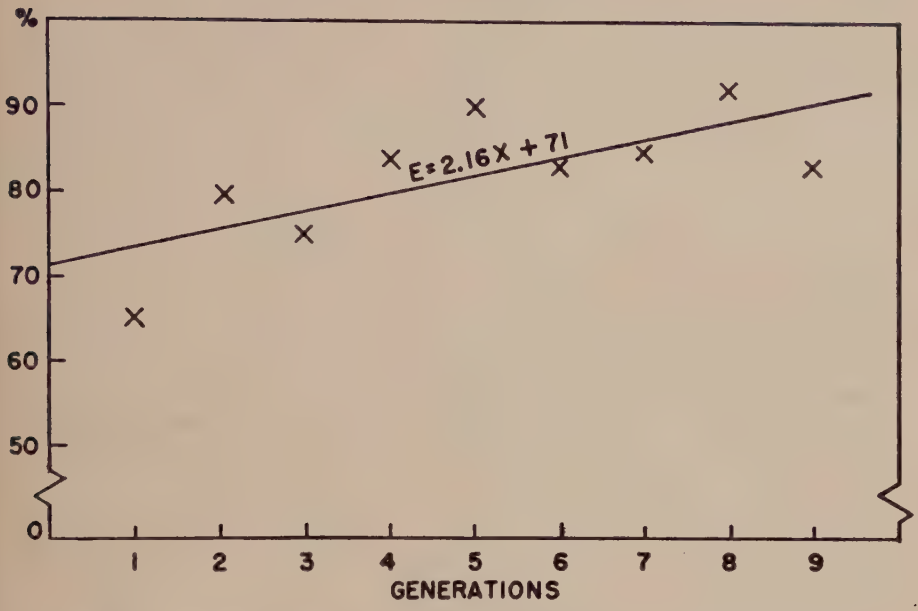

Fig. 1. Hatching percentage of nine generations of Cornish chickens.

of fertile eggs hatched. The method of determining fertility was by candling on the eighteenth day in most instances, but the initial set each year was candled generally on the seventh day of the incubation period. About four-fifths of the fertility was determined on the eighteenth day. This is routine commercial hatchery procedure but it is not ideal, of course, for experimental purposes because of the difficulty of distinguishing infertile eggs from those having very early dead germs. Just how much error resulted from the routine method of candling used must remain a matter of opinion. At any rate, the error is uniform from year to year.

TABLE I—Average hatchability of Cornish pullet progeny for nine generations

	1942*	1943	1944	1945	1946	1947	1948	1949	1950	
Number of pullets	14	40	60	59	35	34	92	39	54	
Percentage hatch of fertile eggs	65	79	75	84	90	83	85	92	83	
Average nine generations										82

*Parental generation.

THE ENVIRONMENT OF PARENT STOCK

Variations in environment from year to year are unavoidable. In this experiment the environmental factors which might influence hatching power were minimized to some extent by the general method of management.

All pullets were housed constantly in identical pens throughout the hatching season in a community house which faced the east. Windows in each pen were of the same size and type and consisted of ordinary window glass which is known to filter out most of the ultraviolet light. Vitamin D requirements were met presumably from a uniform source in the feed. Electric lights were used in all pens to provide a 13-14-hour light day. In winter, heat was provided in the house to keep the temperature in all pens above 45-50 degrees F. Floors were of concrete covered with a wheat straw litter which was changed when it became wet, this occurred from once to as many as four times per month.

FEED[2]

The feed offered the birds throughout the years consisted of mash mixtures popular at the time and scratch grains. From 1942 to 1946, the mash was fed in hoppers open at all times, and the scratch was fed in the straw litter, usually in the evening in an amount equal to the estimated mash[3] consumed. After that the grain ratio was increased to twice the estimated mash intake.

The approximate mash mixtures offered the birds are indicated in Table 2. Changes in mash mixtures were slight during the nine-year period. The principal change was in the fall of 1947, prior to the 1948 hatching season. The scratch grain offered the birds consisted usually of corn, wheat and oats in equal parts by measure. It is impossible of course to determine just what the nutrient intake of individual birds may be under the usual community flock system of management, when the feed consists of more or less natural products such as corn, wheat, oats, bran middlings, alfalfa, meat scrap, fish meal, fed free choice. It can be assumed only that individuals adjust their intake of the various nutrients to suit their particular requirements. It can be assumed only that their reproductive performance is inherent and not nutritional. It is very important to know that all of the parent stock had

[2]Prof. J. A. Davidson was responsible for feed formulas during 1942-46 after which Dr. A. C. Groschke assumed this responsibility.

[3]In 1942 and 43 the ration consisted of "all mash" adjusted to the same ratio.

the same nutritional opportunity throughout the period. In fact, in the flock system of management with more or less natural feed products offered free choice, it is difficult to prevent the birds from getting essential nutrients. Kennard, Bethke and Chamberlin (1948) have shown that the kind of litter and litter management are factors in the sources of certain compensating trace elements.

STORAGE OF EGGS

It is well known that the length of the storage period of eggs and air conditioning during storage are factors which influence hatchability. Storage of the eggs involved in this report was reasonably uniform for each year. Eggs from each pen were accumulated in storage for 2

TABLE 2—Mash mixtures offered, in pounds

	All mash 1942-1943	Laying mashes	
		1944-1947	1948-1950
Ground yellow corn	740	350	350
Ground oats	300	354	254
Wheat bran	300	300	300
Wheat middlings	300	300	300
Alfalfa meal (17%)	60	150	150
Soybean oil meal	70	150	250
Meat scraps	40	100	100
Fish meal	50	100	100
Dried milk	40	60	60
Oyster shell flour	20	40	40
Steamed bonemeal	20	60	60
Salt (iodized)	12	20	20
Fish oil (400D, 3000A)	8	16	16
Manganese sulfate	0.25	0.5	0.5
Dried whey	20	.....	.....
Totals	1,980.25	2,000.5	2,000.5

weeks in a basement room where the temperature seldom varied from a range of 50-70 F. Some of the eggs from almost every pullet were as much as 14 days old when set but this procedure has not been considered seriously detrimental.

MATINGS DURING THE HATCHING SEASON

In 1942 the pullets were mated with Cornish cockerels. From 1943-1947 all the Cornish pens were mated alternately with Cornish and Leghorn males in an attempt to get approximately equal numbers of

purebred and crossbred chicks in each hatch. From 1948 to 1950, inclusive, pullets were mated with Cornish males (Henderson, 1951).

DISCUSSION OF RESULTS

The data in Table 1 and Fig. 1 indicate an upward trend in hatching percentage from one year to the next. The logical question which arises, of course, is that of statistical significance. It is evident that the hatchability of the first generation is 17 percent below the average of all the generations, but after the first generation, improvement is not very definite. In order to estimate the probability of significance a trend (regression) line has been fitted to the data by the method of least squares. The graph of the trend line is shown in Fig. 1. The formula calculated for the regression line is $E = 2.16 x - 71$. In other words, hatchability has increased in succeeding generations at the rate of 2.16 percent per year. The rate of increase is significant ($t = 2.84^*$) by methods given by Fisher (1930).

SELECTION OF PARENTS FOR EACH GENERATION

In the case of the second generation all the members of the first generation contributed to the progeny of the second generation but from the second generation on selection for parenthood was arbitrary. Selection was based on egg producing ability primarily and therefore selection for hatching ability was at random. Whether improvement might have been more rapid if selection had been based exclusively on the highest hatching portion of the population must remain a matter of speculation. A number of high-hatching pullets were eliminated each year for production reasons. Therefore, they did not contribute to subsequent generations.

Somewhat the same unavoidable bias exists, however, in all progenies, for example, potentially high-performing individuals by one criteria may be eliminated by other criteria or death and as a result their ability may not be recorded. There were usually enough males from "200-egg" dams that were better than average in hatchability to permit selection of sires by both criteria, in every generation.

* $P < .05$.

SUMMARY AND ABSTRACT

The hatching power of nine generations of a Dark Cornish population of chickens has been recorded at the Michigan Agricultural Experiment Station as follows (in percentage): 1942-65; 1943-79; 1944-75; 1945-84; 1946-90; 1947-83; 1948-85; 1949-92; 1950-83. The average is 82 percent of fertile eggs hatched. The formula of the regression (percent hatch on years) is: $E = 2.16 x + 71$. $t = 2.84^*$.

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*Statistically significant.

THE EARLY RED RASPBERRY

By STANLEY JOHNSTON
DEPARTMENT OF HORTICULTURE

The Michigan Agricultural Experiment Station announces the introduction of a new red raspberry variety which has been named Early Red.

Early Red originated at the South Haven Experiment Station from a cross between Lloyd George and Cuthbert (Lloyd George x Cuthbert) made in 1931. Since then the variety has gone through a long testing period at the South Haven Station and a 10-year commercial test in the famous raspberry producing area near Benton Harbor.

Photo—K. K. Vining

Fig. 1. A cluster of berries of the Early Red variety.

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The early maturing season of Early Red is of particular value as production then is usually smaller and prices higher than for later varieties. There is a scarcity of good early maturing varieties of the red raspberry.

Plants of Early Red are upright, tall, vigorous, hardy, and very productive. Canes are numerous, moderately stocky, and quite thickly covered with stiff, sharp, reddish-brown prickles like those of Lloyd George. Leaves are large, ridged, dark green on the upper surface and very silvery underneath.

The berries mature early and are large, round-conic, light red when first ripe turning rather dark when fully ripe. The fruit separates from the torus rather easily. This is important as the berries are easy to pick while firm and harvesting can be done before the berries are too soft and too dark.

The flesh is somewhat soft when fully ripe. This may limit shipment of the fruit to nearby markets. However, no complaints have been received over a period of several years in which berries of this variety have been shipped from Benton Harbor to Chicago and other midwestern markets.

Photo—K. K. Vining

Fig. 2. Pint cups of Early Red raspberries ready for market.

Early Red has inherited much of the excellent flavor of Cuthbert. The fruit withstands the canning process very well without crumbling. It freezes as well as Latham, the leading commercial red raspberry.

While the berries begin maturing early, the ripening season is long. The very good flavor and long ripening season of Early Red should make it a popular variety for home gardens.

No virus diseases have been found in test plantings of Early Red to date. However, this may be entirely a matter of chance and no immunity to such diseases is implied.

The limited number of plants available are being distributed among nurserymen specializing in raspberry plant production. This will insure a stock of plants for all at the earliest possible date. The Experiment Station has no plants for general distribution.

POSSIBILITIES OF USING COLORED LIGHTS FOR DETECTION OF CULL CHERRIES

By G. M. PETERSON[1] *and W. M. CARLETON*[2]
DEPARTMENT OF AGRICULTURAL ENGINEERING[3]

Experiments on cherries indicate that the problem of detecting small but major defects in fruits and vegetables during processing may be solved by the use of colored lights.

In cherries, and in almost every other fruit and many vegetables, there are two problems associated with culling work. One is to make certain that the fruit is viewed on all sides by the inspectors so that the culls will positively be seen. The other major problem is to find a type of light that will reveal defects in order that they may be more readily detected. The experimental testing completed in the past season was mainly concerned with this latter problem, that of finding a type of light which would show up the defects advantageously.

METHOD

Preliminary work was accomplished in a laboratory of the Agricultural Engineering Department. All of the work in which the product was involved was undertaken in 13 processing plants, which cooperated in the program of checking lights.

In the processing plants two methods were used in gathering information. First, the opinions of experienced personnel were sought and recorded. Second, the efficiency of the sorters working under the colored lights was checked and a comparison made with the efficiency of sorters under existing white fluorescent lights. The efficiency of the workers was checked in two ways: by a spot check on the percentage of cull cherries removed from the total percentage of cull cherries in

[1]Former Graduate Assistant, Department of Agricultural Engineering.
[2]Associate Professor, Department of Agricultural Engineering.

Acknowledgments:

[3]Special credit is due the following processing plants for cooperation on this project: Michigan Fruit Canners, Benton Harbor and South Haven; John C. Morgan and Co., and Cherry Growers, Inc., Traverse City; Garnsey Company, Ida; State Industries, Inc., Jackson; East Jordan Canning Company, East Jordan; and the Onekama Packing Company, Onekama.

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each batch, and by tabulating the actual weights of cull cherries removed at each table or for a designated number of individuals.

The method of measuring efficiencies involved selecting one sample of the cherries from the conveyor belt (Fig. 1) immediately before the cherries were delivered to the inspection table and taking a second sample immediately after the cherries had been picked over and were

Fig. 1. Cherry sorters at work on a line in a processing plant.

past the inspection table. The belts were timed in order that the samples might be taken from approximately the same location on the belt and from the same batch of cherries. Each sample consisted of 100 cherries. Samples were taken every half hour, or as soon as time would permit. The same methods that are used by the U. S. Department of Agriculture in official inspections were used in checking the experimental samples. The weight of the culls from the sorters under the colored lights was compared with that of culls obtained from sorters under white fluorescent lights.

The culls picked off the inspection tables under test, or the culls for a certain number of individual sorters, were segregated and weighed. The workers were rotated during the test period in an attempt to compensate for differences in efficiency.

Based on the preliminary work in the laboratory, two types of fluorescent lighting, blue and red, were selected for culling work on Montmorency and Philips cherries. The lights either brightened the defect or brightened the body of the cherry and darkened the defect, thereby increasing brightness contrast.

RESULTS

The results from experimentation on blue and red fluorescent lighting are summarized as follows:

BLUE FLUORESCENT LIGHTING

Blue fluorescent lights increased the ability of sorters to see defects, particularly brown spots which seemed the same as in natural daylight. The ability to see every detail of the defects was increased over the use of white lights. The efficiency of the workers using blue fluorescent lights was increased 10 to 30 percent over sorters working under white fluorescent lights. The workers on the night shift preferred blue fluorescent lighting because it was said to produce less eyestrain and they became less fatigued; however, as stated later, the blue lights are not suitable for daylight use.

RED FLUORESCENT LIGHTING

Because of the low efficiency of red fluorescent light, pink fluorescent lights with a light red filter attached were substituted. The pink light was about six times more efficient than the red. Pink fluorescent

lights greatly increased the contrast between the body of the cherry and the defective portion, much more so than did the blue lights.

Ten 2-hour tests with red fluorescent light indicated an increased average sorting efficiency of 64 percent over white fluorescent light. The use of a red light involved an adjustment of the workers' eyes to the different lighting conditions. After the eyes became adjusted, the red light seemed whitish, and the light source seemed orangish. Orange is a pleasant color, meeting with little objectionable comment.

DISCUSSION OF COLORED LIGHTING

Blue fluorescent lighting slightly "grayed-down" the surface color of the cherry (appeared darker). When it was used to illuminate the darker cherries, the workers experienced somewhat more difficulty in detecting defects. Another disadvantage was that blue lights were not used successfully in daytime operation. Blue lights give approximately half as much light as do the white fluorescent ones. The low intensity of blue lights and the fact that they made the cherries seem slightly darker were the major reasons why they were not preferred by daytime workers.

Red light increased the ability of the sorter to spot cull cherries; however, the defective portions were "grayed-down" (appeared darker) and did not appear the same as in daylight. This was not a disadvantage in most instances, but it should be considered.

Red lights and blue lights are only about 50 percent as intense as white light per tube. The workers did not object to their use in daytime operation because they made the cherries appear lighter. It is very possible to increase the intensity of red lights to the extent of causing an objectionable glare. This should be avoided.

Because of their low efficiency (3-6 lumens per watt) red fluorescent lights themselves were not used during the project, but more intense pink lights with light-red filters attached were used instead. Pink light gives about 30 lumens per watt. The filters used were of the inexpensive gelatin type (the waterproof variety should be used). They were attached by means of Scotch Tape. The presence of the waterproof filter, securely attached to the fluorescent tube, greatly lessened the danger of light tube breakage, and the fixtures could be lowered as close to the working surface as desired to give the proper intensity of light.

MEASUREMENT OF COLORED LIGHTING

Special precautions have to be taken in the measurement of colored lighting. Since light-sensitive cells in foot-candle meters and exposure meters are adjusted for white light, the readings for colored light only will be in error. In general, cells in light-measuring equipment are more sensitive to colored light. Therefore, in order to correct the colored light reading to the true intensity, a multiplying factor must be used and the light value computed. The multiplying factors for blue, pink and red light are given as follows (when white = 1.00):

Blue—0.50
Pink—0.90
Red —0.70

The actual percentage of light emitted by the colored fluorescent lights (for a given wattage tube) as compared with white light (white =100 percent) is as follows:

Blue—55 percent
Pink—50 percent
Red — 6 percent

It is suggested that since no one light accomplishes everything desired in sorting work, eventually the operators may have to resort to using more than one type of lighting along their processing line. In that event, shields or separate rooms may have to be used in order that the different types of lighting will not interfere with one another.

OTHER ASPECTS OF THE PROBLEM

The background or immediate surroundings of the object being viewed are very important (Fig. 2). Small color differences between similarly colored objects can best be detected if the objects are viewed against a background similar to the average of the objects being inspected. A red background would be suitable for cherries. Since the belts cannot be painted, because of sanitary reasons, either the color would have to be incorporated into the belt by the manufacturer, or a transparent belt of a plastic or plexiglas material would have to be utilized with the desired color placed underneath. Calculations indicate that the cost of a slatted plexiglas belt would compare favorably with rubber belting. The main disadvantage of a slatted plexiglas belt would be that it would be more difficult to maintain. However,

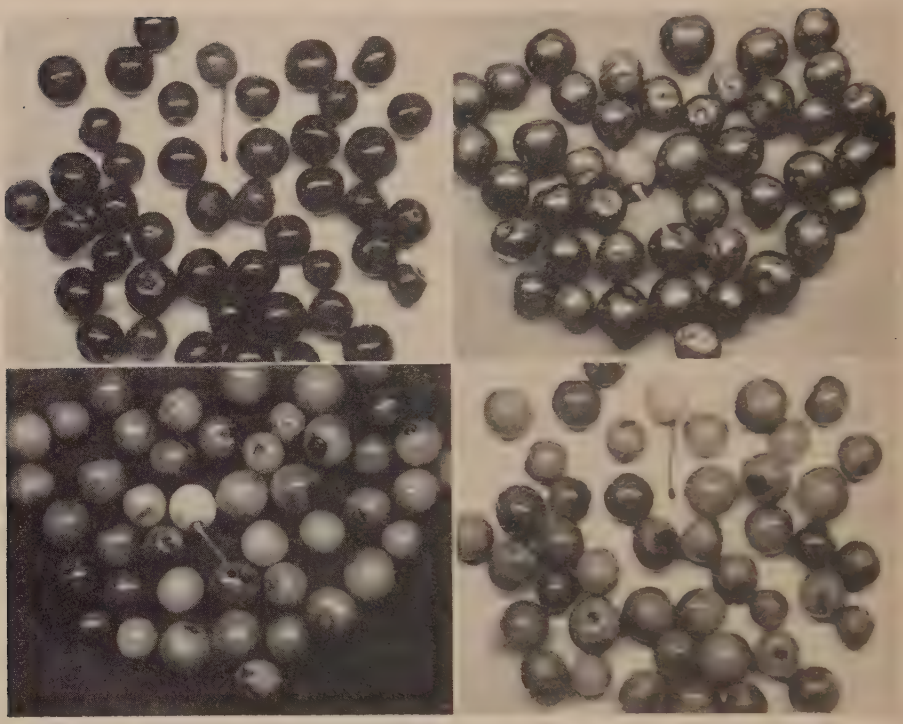

Fig. 2. Samples of cherries under light of various colors, compared with sample under white light:
Upper left—White fluorescent light, white background.
Upper right—Blue fluorescent light, black background.
Lower left—Pink (red filtered) light, black background.
Lower right—Pink (red filtered) light, white background.

the additional cost involved might be more than offset by the benefits to be derived from its use.

With regard to electric sorting of cherries, developments have recently been made by manufacturers of electric sorters which indicate the future possibility of machine sorting of cherries. A waterproof machine, one of the necessities for the cherry industry, has been developed for pea sorting. Existing machines, assuming there were other means of conveying the product, could do the job in three processes; that is, by separating the lighter from the darker cherries, and finally the culls from both. No existing machine will sort cherries in one process.

Foam rubber fingers placed at the half-way point on the inspection belts were tried to aid in turning the cherries for more complete inspection. This method proved to be about 80 percent effective.

SUMMARY

Red fluorescent lighting and blue fluorescent lighting increased sorting efficiency of the workers during short-time tests. The main disadvantage of blue lighting was that blue fluorescent lights had not been used successfully in daytime operation. Pink fluorescent lights with a light red filter attached can be used both day and night. It was necessary to use the attached red filter to obtain the desired results. The pink lights with the attached filter lightened the surface of the cherry and made it easier for the sorters to spot defects. The filter rendered the tubes less susceptible to breakage. The background color was important in emphasizing defects. In the future, this color may be supplied in the inspection belts by one of two methods: by the manufacturer in the color of rubber belts, or by the use of transparent belts with the proper background color placed underneath.

THE HELICOPTER ROTOR AS A MEANS OF CONTROLLING FROST DAMAGE IN FRUIT ORCHARDS

By C.M. HANSEN[1]
DEPARTMENT OF AGRICULTURAL ENGINEERING

The air cools on a still, clear night, and that near the ground cools faster than the air at 200 to 300 feet above the ground. During one test, to be described later in this article, it was found that the temperature at 300 feet above the ground was 48 degrees F., while that near the ground was 26 degrees F. Crops can be kept from freezing under those conditions if the warmer upper air can be mixed with the cooler air near the ground. In California airplane propellers driven by gasoline engines or electric motors have been used in citrus groves for frost prevention, utilizing this warm upper layer. The propeller and power units are usually mounted on towers 30 to 35 feet high.

A new method of accomplishing this purpose is to use a helicopter rotor mounted on a 20-foot tower and operated in much the same way as a stationary helicopter. It pulls the warmer air down and mixes it with the cooler air near the ground. Such a machine was built and tested by the Agricultural Engineering Department. The helicopter rotor was 22 feet long and was made of ponderosa pine. It was mounted on an upright shaft, supported on a tower, and was geared to a 15-horsepower gasoline engine (Fig. 1). It has been operated also by belt drive from the farm tractor. It can be driven by a tractor power-take-off shaft.

Temperature measurements were made within a 400-foot diameter circle by use of electrical thermometers. Temperature readings were also taken to a height of 300 feet above the ground. A hydrogen-filled balloon, 4 feet in diameter, was used to support the electrical thermometers for readings (Fig. 2).

[1]Acknowledgment is made to the personnel of the farm of Wright Stone and Sons, Beulah, and Charles Twigg, County Agricultural Agent, Benzie County, for generous assistance given in conducting tests referred to in this paper.

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Fig. 1. The 22-foot helicopter rotor was mounted on a 20-foot tower. It was powered by a stationary engine or a farm tractor.

RESULTS

Wind speed measurements were made at varying distances from the helicopter rotor tower. The air speed measurements showed that the air movement was greatest between 10 and 20 feet from the tower. Usually the machine did not cause air movement beyond 150 feet (Fig. 3).

During March 1951 this wind machine was installed in the Thorn Hill Orchard owned by Wright Stone and Sons, Beulah, Michigan. This installation was made to test the frost prevention effectiveness of

Fig. 2. Hydrogen-filled balloons, 4 feet in diameter, were used to support thermometers in determining the temperature of the air up to 300 feet above ground.

the machine under orchard conditions. Tests were also made when the wind machine was operated together with a number of orchard heaters.

In the early morning of May 4 a minimum temperature of 31.4 degrees F. was measured near the ground. At this time the temperature 300 feet above the ground was 37.9 degrees F. Shortly after the rotor was started the temperature 40 feet out from the machine rose from 31.4 to 36.0 degrees F. Beyond 170 feet from the machine the temperature did not rise. Seventy-eight heaters in a circle which had a radius of approximately 150 feet from the machine were then lit. These

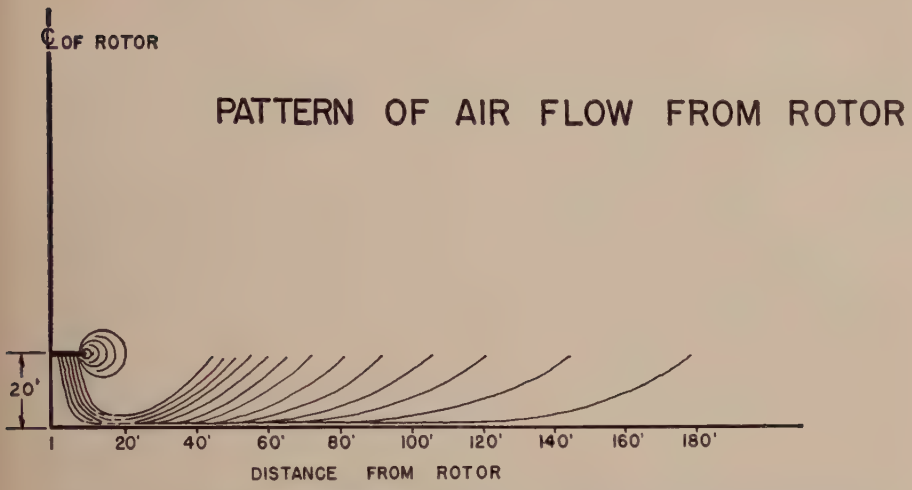

Fig. 3. The air flow pattern set up by the helicopter rotor was studied by means of air speed indicators. The effect of the rotor diminished at a distance of 180 feet.

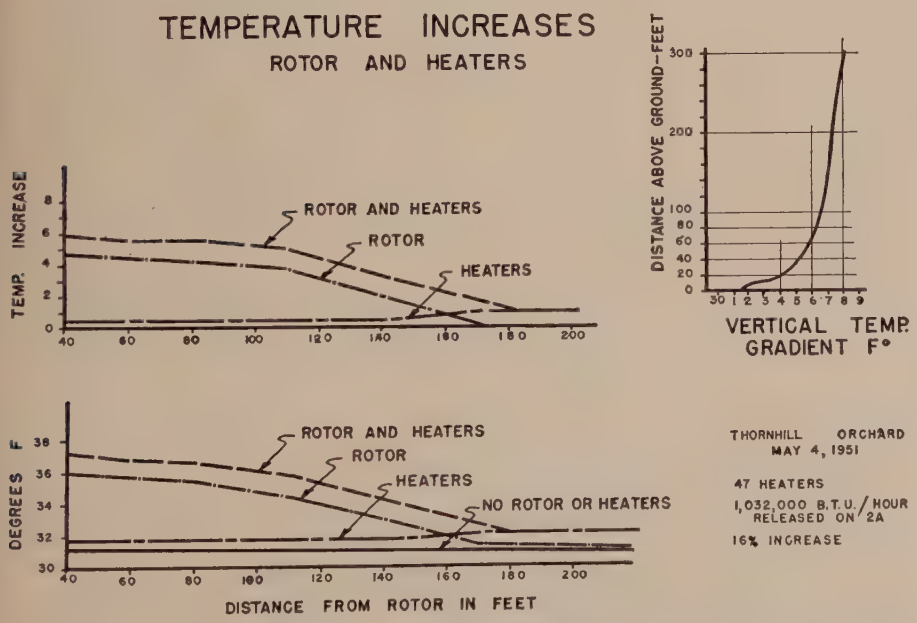

Fig. 4. Graphs showing the relationship between the temperature increase and the distance from the machine when the heaters and rotor were operated together and when they were operated separately. The temperature of the air above the ground had a definite effect (upper right hand graph) on the temperature rise produced by the wind machine.

heaters raised the temperature from 31.4 to 31.9 degrees F. over the area. When the heaters and wind machine were used together, the temperature at a distance of 40 feet from the machine increased from 31.4 to 37.2 degrees F. No increase in temperature was measured beyond 180 feet (Fig. 4).

The average temperature rise for the wind machine alone was 3.5 degrees F. and that for the heaters alone was 0.5 degree F., making a probable increase of 4.0 degrees F. for the wind machine and heaters operating at the same time. Actually, the average temperature rise was 4.6 degrees F., an increase of 0.6 degree F. above what was expected. This increase is believed to be due to recirculation of the heat given off by the heaters.

A more severe frost occurred on the night of May 11. The lowest temperature at the ground level was 26 degrees F. The temperature at 300 feet above the ground was 48 degrees F. Approximately one-half hour after the rotor was started the temperature 40 feet out from the machine had risen from 26 to 35 degrees F. No temperature increase was recorded beyond 170 feet northwest from the machine.

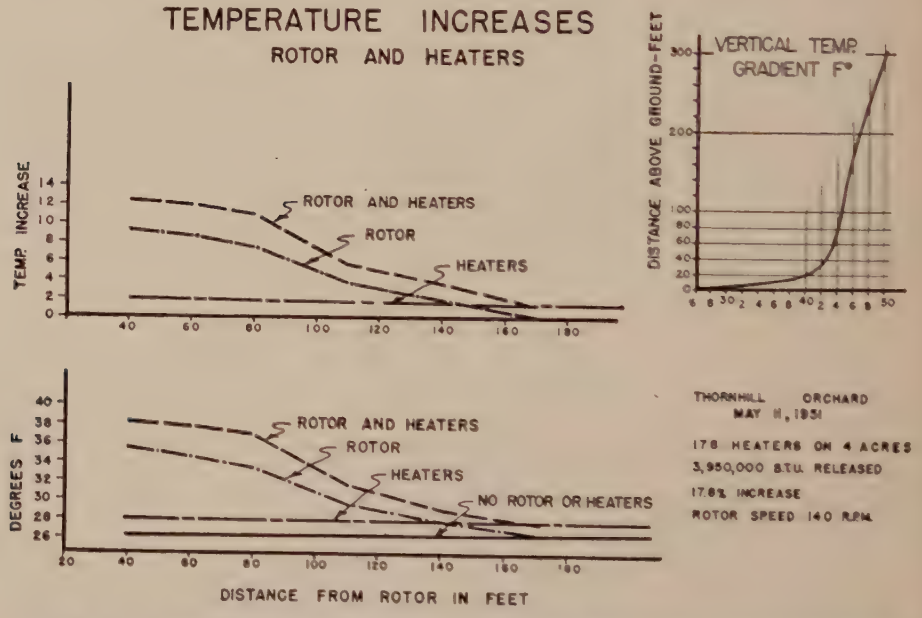

Fig. 5. Graphs showing the relationship between the temperature increase and distance from rotor. A much greater difference in temperature was realized in this test than during the previous test (Fig. 4).

The temperature increase brought about through the use of 178 heaters was 1.7 degrees F. When the machine and heaters were used together the temperature at 40 feet from the wind machine rose from 26 to 38 degrees F. No temperature increase was recorded beyond 170 feet in a northwesterly direction from the machine (Fig. 5).

The average temperature rise for the machine alone was 5.1 degrees F., and that for the heaters was 1.7 degrees F., making a probable increase of 6.8 degrees F. if both were used together. The actual temperature rise, however, was 8.0 degrees F., representing an increase of 1.2 degrees F. above the expected increase. Again, the temperature increase of 1.2 degrees F. is no doubt due to the recirculation of heat given off by the heaters. During this test the wind machine replaced approximately 200 heaters.

The work on the use of this helicopter rotor for frost control purposes started in the spring of 1950. It has been operated in two orchards and in an open field. The study thus far indicates that the machine operated without added heat will be beneficial only when there is a wide difference in the temperature of the air near the ground and that at 200 to 300 feet overhead. The greater the difference in temperature, the greater will be the benefit that can be realized. (Fig. 6).

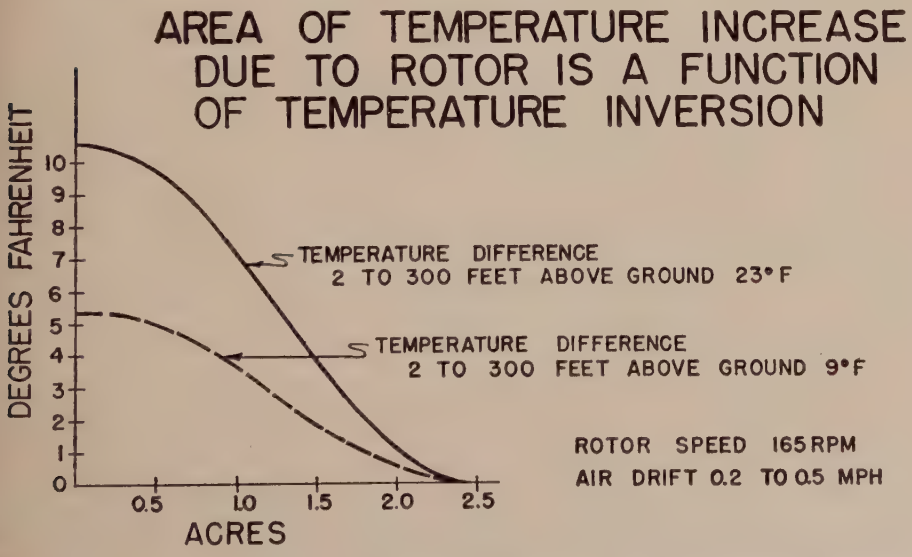

Fig. 6. Graph showing the relationship between the temperature increase due to rotor alone and the area affected, in acres, with respect to the difference in the air temperature near the ground and overhead.

SUMMARY

A helicopter rotor was mounted and operated on a 20-foot tower. The action of the rotor brought the warm upper air down to the orchard during still air frost. It also caused a recirculation of the heated air released by orchard heaters. The following conclusions can be drawn from the study:

1. The use of the helicopter rotor for frost control purposes is still in the experimental stage but offers promise of a practical frost control apparatus for certain conditions. A study needs to be conducted, however, on the interaction of several units.

2. Under Michigan conditions it will be necessary to have stand-by orchard heaters in the event there is no warm air overhead.

3. If heaters are used with the machine, they must be set just beyond the influence of horizontal air movement caused by the rotor.

4. The helicopter rotor machine referred to in this report replaced about 200 open-flame heaters.

5. The combination of the machine plus properly spaced heaters gives best results and greatest efficiency. This auxiliary heat, however, may not always be necessary; for example, when the temperature of the air overhead is considerably higher than that of the air near the ground.

JOURNAL ARTICLE ABSTRACTS

The Effect of Copper Fertilization on Carotene, Ascorbic Acid, Protein and Copper Contents of Plants Grown on Organic Soil

LUCAS, R. E.

Soil Science 65(6):461-469. 1948 (Journal Article 926 from the Michigan Agricultural Experiment Station)

Plants grown in muck soils deficient in copper contained one-fourth to one-half as much copper as plants grown in copper-fertilized soil. In greenhouse trials the application of copper to deficient muck soil increased the ascorbic acid content of barley, oats, and fall-grown spinach, but did not affect the ascorbic acid content of spring-grown spinach and tomato fruit. In field-grown crops, onions, spinach, and wheat showed no significant differences in ascorbic acid content. The application of copper increased the carotene content of greenhouse-grown wheat, spinach, barley, carrots, and oats. The protein content of plants deficient in copper was found to be abnormally high.

Chemical and Physical Behavior of Copper in Organic Soils

LUCAS, R. E.

Soil Science 66(2):119-129. 1948 (Journal Article 927 from the Michigan Agricultural Experiment Station)

Copper was found to be held rather tenaciously in organic soils when it was applied as copper sulfate. Soil samples collected five years after a 50-pound per acre application showed that approximately an equivalent of 48 pounds of copper sulfate remained in the upper 8 inches of soil. From an original application of 300 pounds of copper sulfate per acre 232 pounds were found to be in the topsoil.

A large portion of the copper in organic soils could be extracted with one normal nitric or hydrochloric acid, but very little with ammonium acetate.

Copper sulfate was found to precipitate, probably as the hydroxide, in a soil-water suspension when the suspension was less acid than pH 4.7. Studies of equilibrium reactions of copper and hydrogen in organic soils showed that the ratio of adsorbed cations at symmetry concentration was approximately 2 equivalents of hydrogen to 1 equivalent of copper. Saturating a H-muck with copper by leaching the soil with copper acetate showed that there was no simple exchange reaction. Titrimetric studies indicated that the copper was adsorbed as the divalent cation and a monovalent copper acetate cation.

Land Quality and Real Estate Transfers in Ogemaw County, Michigan

SCHNEIDER, IVAN F.

Papers Mich. Acad. Sci., Arts and Letters, Vol. XXXIV, 1948, pp. 185-194. 1950 (Journal Article 984 from the Michigan Agricultural Experiment Station)

Based on the soil survey map of Ogemaw County, the soil types were consolidated into four broad land divisions based upon soil texture, drainage and

slopes, namely: 1) rolling clay soils; 2) level clay soils; 3) predominantly rolling loamy sand and sandy loam soils; and 4) sand plains, sand hills and swamps.

The real estate transfers of over 10 acres for a 5-year period from 1942 to 1947 were studied to determine the relationship between the four broad land divisions and 1) number of real estate transfers; 2) probable use of the land; 3) price paid for land; and 4) residence of purchaser.

The number of real estate transfers increased gradually, reaching a peak in 1945. Agricultural land represented approximately 52 percent and recreational land about 32 percent of the transfers. The price of all recreational land doubled between 1942 and 1945. The price paid per acre for privately-owned recreational land was more than three times the price paid for state-owned recreational land.

Over 95 percent of the transfers in the rolling clay soils division and over 90 percent in the level clay soils division were for agricultural purposes. In the sands-swamp land division, approximately 65 percent of the land transfers were for recreational use with less than 8 percent for agricultural purposes. Over 66 percent of the land sold in the rolling, sandy loam soils division was for agricultural use, with less than 8 percent for recreational purposes.

Over 65 percent of the purchasers of recreational land in Ogemaw County resided in the industrial counties of Michigan, while nearly 80 percent of the buyers of agricultural land lived in Ogemaw or adjoining counties.

The Effect of Streptomycin on Listeria

GRAY, M. L., STAFSETH, H. J., AND THORP, FRANK JR.

Jour. Am. Vet. Med. Assoc. 115:171-173. 1949 (Journal Article 1019 from the Michigan Agricultural Experiment Station)

This report deals with the antibiotic effect of streptomycin against *Listeria monocytogenes.* Listeria cultures were markedly inhibited by 1.0 unit per ml. of tryptose agar after 24-hour incubation at 37° C. However, the organisms developed a fastness for antibiotic very rapidly and could be made to grow in 24 hours on plates containing 10 units of streptomycin per ml. of tryptose agar.

In vivo tests were carried out, using rabbits. The results indicate that streptomycin has no value in treating infections with members of the genus *Listeria.*

Listeria Isolated from the Liver of a Lamb

GRAY, M. L., THORP, F., AND NELSON, R. H.

Jour. Am. Vet. Med. Assoc. 115:103-104. 1949 (Journal Article 1030 from the Michigan Agricultural Experiment Station)

This is a case report of septicemia in an 8-day-old lamb. *Listeria monocytogenes* was isolated from the liver and heart blood. Grossly, the lungs and liver showed a uniform distribution of white necrotic foci. Microscopically, the liver showed varying sized areas of focal necrosis. Gram-positive, rod-shaped bacteria were found throughout the necrotic areas.

Four ewes in the same flock died after showing typical nervous symptoms, and *L. monocytogenes* was isolated from the brains of two of them.

The Use of Radioactive Phosphorus in the Study of the Teeth of Caries Resistant and Susceptible Strains of Albino Rats

HOPPERT, C. A., AND SHIRLEY, R. L.

Jour. Dental Res. 29:29-37. 1950 (Journal Article 1043 from the Michigan Agricultural Experiment Station)

In 1931-32 Hoppert *et al.* demonstrated that dental caries could be developed in rats by feeding diets containing coarsely ground corn or rice. Subsequently, Hunt, Hoppert, *et al.* have made a genetic study in which two distinct strains of Albino rats have been developed that vary markedly in their susceptibility to dental caries. The susceptible and resistant strains have been inbred through 18 and 14 generations, respectively. In the present investigation a comparison of the rates of deposition and removal of radioactive phosphorus in the teeth of these specialized strains and stock colony rats was made. Also, the weight, and the ash and phosphorus content of the teeth were determined.

The data obtained in this investigation of the whole teeth of these two specialized strains indicate that they varied in the following respects:

1. The resistant strain had slightly lighter weight teeth after 30 days of age.
2. The resistant strain contained approximately 2 percent more ash in the molars than the susceptible strain.
3. The resistant strain contained approximately 0.5 percent more phosphorus on the dry weight basis than the susceptible strain.

The two strains were found to be essentially similar in the following respects:

1. Percentage of ash in the incisors.
2. Percentage of phosphorus in the incisors on the dry weight basis, and percentage of phosphorus in the ash of the molars and incisors.
3. Rate of deposition and removal of radioactive phosphorus in the teeth when the isotope was administered intraperitoneally.
4. Occurrence of radioactive phosphorus in the teeth of offspring of females that were injected intraperitoneally with the isotope during pregnancy.
5. *In vitro* adsorption of the isotope by the teeth from aqueous solution.

Nutrient Deficiencies Diagnosed with Foliar Analyses and Plant Tissue Tests

LYND, J. Q., TURK, L. M. AND COOK, R. L.

Agron. Journ. 42:402-407. 1950 (Journal Article 1050 from the Michigan Agricultural Experiment Station)

Greenhouse and field experiments were undertaken to compare plant tissue testing and foliar analysis as to precision in detecting soil fertilizer treatment. A special effort was made to determine which portion of the plant is a reliable indicator of its nutrient status and to determine the time of sampling most suitable for these tests. Soil testing procedures were used to indicate the relative fertility levels of the soils.

Tissue testing was found to be a reliable method for detecting soil fertilizer treatments for the elements nitrogen, phosphorus, and potassium on soil types differing widely in physical and chemical characteristics. The third functioning basal leaf of corn plants, as used in the tissue tests and foliar analyses, was found to be a reliable indicator of the nutrient status of the plant.

A method for determining manganese in fresh tissue was found to give a good indication of the total manganese present in the foliage of white bean plants.

Periodic foliar analysis of corn plants through the season indicated that there must be some physiological basis, other than visual estimation for selecting comparable plants in making practical interpretations of test results.

Chemical Studies on Oats. I. Thiamine, Niacin, Riboflavin, and Pantothenic Acid

FREY, K. J., AND WATSON, G. I.

Agronomy Jour. 42(9):434-436. 1950 (Journal Article 1108 from the Michigan Agricultural Experiment Station)

Sixteen varieties and strains of oats were analyzed for niacin, riboflavin, thiamine, pantothenic acid, and protein. Niacin content ranged from 4.4 micrograms per gram of oats in Huron variety to 11.7 in C.I. 5298, while thiamine content ranged from 5.37 micrograms per gram in Mindo to 9.69 in C.I. 5298. All 16 varieties contained enough thiamine to meet the dietary requirements of swine as set up by the National Research Foundation. Riboflavin content ranged from 1.05 micrograms per gram of oats in Mindo variety to 1.87 in Worthy, while pantothenic acid content ranged from 6.3 micrograms per gram in Andrew variety to 12.7 in Wolverine. All of the varieties were found to be too low in riboflavin to meet the dietary requirements of swine as set up by the National Research Foundation, and all varieties except Wolverine were too low in pantothenic acid.

There were shown to be significantly positive correlations between total protein and niacin and thiamine, and niacin and riboflavin and thiamine. Pantothenic acid was found to be correlated negatively with protein, niacin, riboflavin, and thiamine.

A Genetic Study of 17F_1 Hybrids and Their Inbred Parents

KOHLS, H. L.

Proc. Am. Soc. Sug. Beet Tech. Pages 165-170. 1950 (Journal Article 1142 from the Michigan Agricultural Experiment Station)

Seventeen hybrids involving 15 inbred strains of sugar beets used as male parents were made and tested in the field one season. From this field data it is believed that the yielding ability of F_1 hybrids cannot be predicted from the yielding ability of the parents. Percentage of sucrose, purity of juice, and smoothness of root are about intermediate between the two parents and can be predicted fairly accurately. Resistance to Cercospora leaf spot can be predicted only to the extent that the F_1 is more like the least resistant parent. Some hybrids are less resistant than the least resistant parent. If the two parents are about equal the hybrid may be equal to the two parents in resistance.

Evaluation Tests in 1949 of Hybrid 125

KOHLS, H. L.

Proc. Am. Soc. Sug. Beet Tech. Pages 171-175. 1951 (Journal Article 1143 from the Michigan Agricultural Experiment Station)

Sugar beet hybrid No. 125 was included in 25 tests in the Eastern Slope and Eastern Areas in 1949. These tests show that this hybrid is well adapted in the

Eastern Area where it averaged 1.79 tons per acre, or 12 percent above the commercial variety. The data are very similar to those from similar tests in 1948.

The Occurrence of Antibacterial Substances in Seed Plants with Special Reference to Mycobacterium tuberculosis. Second Report on Screening Tests

LUCAS, E. H., LICKFELDT, ARDETH, GOTTSHALL, R. Y., AND JENNINGS, J. C.

Bul. Torrey Botanical Club 78(4):310-321. 1951 (Journal Article 1172 from the Michigan Agricultural Experiment Station)

The paper reports the results of the second year of screening tests conducted to determine antibacterial substances in seed plants. Species belonging to 87 families were tested during two consecutive years. Seventy-one families appear in the test covered by the present report, 37 of which had representatives in the first year's test. The total number of species investigated in two years is 360, of which 199 are enumerated in this paper.

Forty-two species were found to contain principles controlling the growth of *M. tuberculosis*, 19 of which had specific activity. Antibacterial action against *Staph. aureus*, *S. typhimurium*, and *E. coli* was also recorded.

A Study of the Pathology of the Chick Embryo Infected with a Transmissible Agent Isolated from Sheep Lungs

RAMIREZ, ALEXANDER M., GRAY, M. L., AND THORP, FRANK, JR.

Am. Journ. Vet. Res. 12(44):201-205. 1951 (Journal Article 1176 from the Michigan Agricultural Experiment Station)

A non-bacterial agent was isolated from pneumonic lungs of sheep and propagated in developing chicken embryos through 19 serial passages by means of C. A. membrane inoculation. The predominant lesion produced was a pneumonia characterized by lymphocytic infiltration which was similar to that seen in the original lungs.

The Vitamin B_6 Content of Fresh and Stored Shell Eggs

EVANS, R. J., BUTTS, HELEN A., AND DAVIDSON, J. A.

Poultry Sci. 30(4):515-519. 1951 (Journal Article 1178 from the Michigan Agricultural Experiment Station)

Eggs from ten White Leghorn hens kept in individual laying cages were assayed for vitamin B_6 with the "pyridoxinless" mutant, No. 299, of *Neurospora sitophila*. Fresh eggs and eggs from each hen that were stored at 0° C. for 3, 6, and 12 months were used. Fresh shell eggs contained on the average 123.6 μg. of vitamin B_6 per egg or 2.52 μg. per gm., egg white 68.1 μg. per white (2.17 μg. per gm.), and egg yolk 54.6 μg. per yolk (3.08 μg. per gm.). The vitamin B_6 content of the eggs decreased during cold storage. Approximately half of the vitamin B_6 was lost in 12 months.

The Survival of Selected Enteric Organisms in Various Types of Soil

MALLMANN, W. L., AND LITSKY, WARREN

Am. Journ. Pub. Health 41(1):38. 1951 (Journal Article 1196 from the Michigan Agricultural Experiment Station)

A bacteriological examination of sewage was made to determine the presence of enterics and organisms that might be used as indicators of sewage pollution. Out of 672 cultures isolated from sewage, 274 were Pseudomonas, 34 were Proteus, 11 were paracolons, 17 were Alkaligenes and 1 was S. typhosa. Various soils were treated with raw sewage and quantitative examinations made for coliforms and enterococci. A reduction of coliform occurred although the recution trend was neither rapid nor constant. The enterococci died out more rapidly than did the coliform. The longevity of the enterococci was greater in soil of high organic contents. When S. typhosa was added to sewage-treated soils, the enterococci persisted longer than S. typhosa. The enterococci seem to be good indicators of public health hazard in sewage-treated soils.

Effects of Corpora Lutea Removal and Replacement with Progesterone on Pregnancy in Goats

MEITES, J., WEBSTER, H. D., YOUNG, F. W., THORP, F., JR., AND HATCH, R. N.

Journ. An. Sci. 10(2):411-416. 1951 (Journal Article 1197 from the Michigan Agricultural Experiment Station)

1. Laparotomies were performed on 21 goats either on the 100th or 125th day of gestation. All or some of the corpora lutea were removed from 19 goats and the entire ovaries were removed from two goats. Eight goats received no further treatment, while 13 goats were injected daily with 25, 15 or 10 mg. of progesterone.
2. Excision of all the corpora lutea in four goats and of both ovaries in one goat resulted in prompt abortion 2 days later, confirming the need for the corpora lutea during the last third of pregnancy in goats.
3. In 20 of the 21 goats the number of corpora lutea found in the ovaries corresponded to the number of fetuses. Excision of only one of two corpora permitted three goats with two fetuses each to continue in pregnancy for variable periods of time, indicating that more progesterone is normally secreted by the corpora lutea than necessary to maintain gestation.
4. When all the corpora lutea were removed, subcutaneous injections of 25 mg. of progesterone daily maintained pregnancy in three of three goats, 15 mg. in four of four goats and 10 mg. in four of six goats. It is concluded that the progesterone requirements of goats is of the order of 10 mg. daily during the last third of pregnancy.

The Fruit-Setting Factors from the Ethanol Extracts of Immature Corn Kernels

REDEMANN, C. T., WITTWER, S. H., AND SELL, H. M.

Archives of Biochemistry and Biophysics 32(1):80-84. 1951 (Journal Article 1207 from the Michigan Agricultural Experiment Station)

The ethyl ester of indole-3-acetic acid has been identified as the substance responsible for the ability of the ethanol extractive from immature corn kernels

to induce parthenocarpy in the tomato. The methods of isolation and characterization are described.

The Characterization of Indole-3-Acetic Acid and Its Esters

REDEMANN, CARL T., WITTWER, SYLVAN H., AND SELL, HAROLD M.

Jour. Am. Chem. Soc. 73:2957. 1951 (Journal Article 1208 from the Michigan Agricultural Experiment Station)

The physical properties of the 1, 3, 5-trinitrobenzene adducts of indole-3-acetic acid and of a series of esters of indole-3-acetic acid are described. The properties method of preparation of the *n*-butyl and *n*-amyl esters of indole-3-acetic acid are also presented.

Is It Necessary to Use a Detergent for Washing Cucumbers for Fresh Pack?

FABIAN, F. W., AND JACOBS, P. D.

Food Packer 32, 32-33:66, 1951 (Journal Article 1221 from the Michigan Agricultural Experiment Station)

It is very necessary to have fresh cucumbers free of dirt and soil when they are packed directly into jars, brined and pasteurized because the presence of soil is very objectionable. Large factories appreciate this so they wash the fresh cucumbers three times. First the cucumbers are soaked, then they are put through a vegetable washer and, finally through a spray washer under 300 to 400 pounds pressure per square inch. These three washings get rid of practically all dirt. The small pickle packer does not have the equipment to do such a thorough job of washing. Consequently, it is necessary for him to use a detergent to assist in getting rid of the dirt. The detergent is added to the first wash water in which the cucumbers are allowed to soak about 20 minutes. The detergent is then rinsed from the cucumbers. Results show that this simplified procedure produced a dirt-free cucumber and is recommended when only washing is used.

The Solar-Activated Flavor of Homogenized Milk. V. The Electrophoretic Analysis of a Contributing Minor-Protein Fraction

WEINSTEIN, B. R., LILLEVIK, H. A., DUNCAN, C. W., AND TROUT, G. M.

Jour. Dairy Sci. 34(8):784-789. 1951 (Journal Article 1227 from the Michigan Agricultural Experiment Station)

An electrophoretic examination of the minor-protein fraction and the other whey protein fractions separated during the isolation of the minor-protein fraction has been made. Electrophoretic resolutions of a 1-percent solution of the minor-protein fraction in acetate, phosphate, ammonia and veronal-citrate buffers were studied at pH ranges from 3.3-9.3 by use of a Perkins-Elmer electrophoresis apparatus. Analyses of the minor-protein fraction indicate that this fraction is composed of at least two components or complexes.

A series of patterns was secured from the whey and heat-coagulated-whey proteins obtained in the course of the isolation of the minor-protein fraction. The whey proteins were studied in acetate, phosphate and veronal-citrate buffers at pH ranges from 3.3-7.6 and at various concentrations. Patterns of the heat-

coagulated-whey serum proteins were made in veronal-citrate buffer at pH 7.6. The patterns secured with these two fractions indicate that the heat-labile whey components were effectively removed by the fractionation procedure employed.

Best electrophoretic resolution and enantiography of all of the whey proteins were effected with veronal-citrate buffer at pH 7.6.

Listeriosis in Young Lambs

GRAY, M. L., JOHNSTON, R. L., AND THORP, FRANK, JR.

MSC Vet. 11(3):108, 136. 1951 (Journal Article 1228 from the Michigan Agricultural Experiment Station)

Listeriosis in young animals usually manifests itself as a septicemia, while in adult animals it occurs as an encephalitis. Two outbreaks in lambs less than one month old are reported in which the disease occurred in the encephalitic form without any evidence of septicemia. In the first outbreak two lambs died while at least three died in the second outbreak. The disease was confirmed by isolation (from the medulla) and identification of *Listeria monocytogenes* and by the presence of typical microscopic lesions in tissue sections taken from the medulla.

Heat Inactivation of Threonine, Glycine, and the Acidic Amino Acids

EVANS, ROBERT JOHN, BUTTS, HELEN A., AND BANDEMER, SELMA L.

Archives of Biochemistry and Biophysics 32(2):300-308. 1951 (Journal Article 1230 from the Michigan Agricultural Experiment Station)

Little or no destruction of threonine, glycine, aspartic acid, and glutamic acid occurred when soybean oil meal, soybean protein, or the protein plus sucrose, glucose, dextrin, agar-agar, gum arabic, or soybean oil was autoclaved for 4 hours at 15 pounds pressure. A portion of each of these amino acids was "inactivated" or tied up in such a manner that the biologically active amino acid could be liberated by acid but not by *in vitro* trypsin and erepsin digestion. The data indicated that two types of inactivation occurred during autoclaving. Protein-bound threonine, glycine, and glutamic acid reacted with sucrose or glucose to form a linkage resistant to enzymatic but not to acid digestion. Protein-bound aspartic and glutamic acids reacted with some other constituent of the protein to form a linage resistant to trypsin and erpsin digestion *in vitro* but hydrolyzed by acid digestion. The free carboxyl groups possibly react with the free amino groups of lysine and arginine and with the imidazolyl group of histidine to form a peptide-type linkage resistant to enzymatic cleavage.

Genetic Differences in Quantitative Histology of the Adrenal, Organ Weights, and Inter-Organ Correlations in White Leghorn Chickens

OAKBERG, EUGENE F.

Growth 15:57-78. 1951 (Journal Article 1231 from the Michigan Agricultural Experiment Station)

Quantitative histology of the adrenals and body and organ weights were studied for 158, 120-day, male and female White Leghorn chickens from four inbred lines. Individual birds differed significantly in percentages of adrenal cortex and

medulla; sex differences were influenced by the particular lines. Likewise, family differences in percentage composition of the adrenal were observed in some lines but not in others. Correction for body weight reduced most inter-organ correlations, but specific relationships also were indicated. The data are discussed in relation to growth patterns of the respective lines, and it is concluded that genetic constitution is an important variable in all comparisons.

Influence of Genetic Constitution on Growth of Lymphoid Tissue in Liver and Pancreas of White Leghorn Chickens, and Correlation of Lymphoid Tissues with Weights of Some Visceral and Endocrine Organs

OAKBERG, EUGENE F.

Growth 15:79-100. 1951 (Journal Article 1259 from the Michigan Agricultural Experiment Station)

Lymphoid tissues of liver and pancreas were studied for 158 male and female chickens of four inbred lines. Significance of line and family differences indicates that genetic constitution is an important variable in growth and development of ectopic lymphoid foci. A low correlation between growth of lymphoid tissue in liver and pancreas was demonstrated; also, amount of lymphoid tissue in liver and pancreas was correlated with pancreas and spleen weights. Amount of lymphoid tissue in the pancreas of 120-day females gave a positive, significant correlation with incidence of leucosis in sibs kept for 600 days. However, the number of areas in the liver gave a similar significant positive correlation with ability to survive death from all causes. These data are discussed in relation to endocrine control of lymphoid tissues and in relation to interpretation of ectopic lymphoid foci in birds.

Report on Zinc in Plants

HEINEN, EUNICE J., AND BENNE, ERWIN J.

Jour. Assoc. Official Agr'l Chem. 34(3):692-697. 1951 (Journal Article 1272 from the Michigan Agricultural Experiment Station)

In certain cases of malnutrition of plants it is of value to be able to determine the small amounts of zinc present in the tissue. Consequently, a study of chemical analytical methods for this purpose has been under way in the authors' laboratory for a number of years. The present article presents a revision of the Association of Official Agricultural Chemists' diphenyldithiocarbazone method for determining zinc in plant tissues. For a given material, zinc values obtained by use of the revised procedure agreed very well with those evaluated by the method of the Association. The revised procedure eliminates certain manipulative steps and the use of certain reagents, resulting thereby in a considerable saving of time in making a given number of analyses.

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